Search for Environmental Influences on the ^{7}Be Decay Rate

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^{7}Be plays an important role in the generation of solar neutrinos. Because ^{7}Be decays via electron capture, its half life depends on the electron density at the nucleus. At the center of the Sun, ^{7}Be is fully ionized, and the electron capture rate must be calculated using the terrestrially determined nuclear matrix elements and estimates of continuum electron densities and energies.

Two groups have recently reported observations of relatively large variations in the decay rate of ^{7}Be as a function of the physical environment in which the ^{7}Be is located. Souza *et al.* [1] reported that the decay rate of ^{7}Be in tantalum is approximately 1% larger than it is in lithium. On the other hand, Ray *et al.* reported that the decay rate of ^{7}Be in gold is about 0.7% lower than it is in aluminum oxide [2].

To test this idea, we measured the half life of ^{7}Be in four different host materials. Samples of ^{7}Be in graphite, boron nitride, tantalum, and gold were produced at LBNL's 88" Cyclotron. Each ^{7}Be sample was sealed and packaged together with a ^{133}Ba reference source. These composite sources were individually gamma counted in 1-day time bins periodically over 4 months using a 110-cm^{3} coaxial germanium detector. In order to reduce systematic effects from variations in detector or electronic performance, the ^{7}Be half life was determined by comparing the numbers of 478-keV ^{7}Be and 356-keV ^{133}Ba gamma rays observed from each sample.

Results from the analysis of our data are as follows. The half-life of ^{7}Be we observe is: 53.107 $\pm$ 0.022 days in graphite, 53.175 $\pm$ 0.037 days in boron nitride, 53.195 $\pm$ 0.052 days in tantalum, and 53.312 $\pm$ 0.042 days in gold. For comparison, the most precise previous ^{7}Be half life measurements we are aware of are those of Lagoutine *et al.* , 53.17 $\pm$ 0.02 days for ^{7}Be in aluminum [3], and Jaeger *et al.* , 53.12 $\pm$ 0.07 days for ^{7}Be in lithium fluoride [4].

Our results for ^{7}Be in graphite, boron nitride, and tantalum are all in reasonably good agreement with each other and with the measurements reported for ^{7}Be in aluminum and in lithium fluoride [3,4]. This suggests that any variation in the decay rate between these materials is less than 0.1%. We do, however, see a difference of about 0.3% in the decay rate of ^{7}Be in gold as compared to any of the other materials. This value is somewhat smaller than, but is in the same direction as the results of Ray *et al.* Nevertheless, it seems that estimates of the ^{7}Be decay matrix elements based on laboratory measurements of the decay rate cannot be wrong by more than about 0.3%. Thus this effect can at most play a minor role in solving the solar neutrino problem.

Footnotes and References

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4. M. Jaeger *et al.*, Phys. Rev. C **54**, 423 (1996).